ER 65 – Electrician Regulations Answer Schedule

Notes: 1. (1 mark) means that the preceding statement/answer earns 1 mark.

2. This schedule sets out the expected answers to the examination questions. The marker can exercise their discretion and decide on the overall accuracy of any answer that is presented in the candidate's own words.

3. Symbols and terms - alternatives

Power	W or P
Voltage	V or E or U
Phase	Active

Question 1	*Marks*	*Reference*	*Marking notes*
(a) Any TWO of: • Socket-outlet final subcircuits: • Lighting final subcircuits. • Directly connected hand-held electrical equipment	(2 marks)	AS/NZS 30000 1.5.6.3(a) 2.6.3.1(a) AS/NZS 30000 1.5.6.3(a) 2.6.3.1(b) AS/NZS 30000 1.5.6.3(a) 2.6.3.1(c)	
(b) (i) Any ONE of: • Provided with a suitable enclosure • Installed in a cupboard with close-fitting doors	(1 mark)	AS/NZS 3000: 2.9.2.5(b)	
(ii) Have a minimum degree of protection of IPX6	(1 mark)	AS/NZS 3000: 2.9.2.5(g)	
(c) • 230 x 5% = 11.5V	(1 mark)	AS/NZS 3000 3.6.2	
• 230 – 11.5 = 218.5 V	(1 mark)	AS/NZS 3000 3.6.2	
(d) (i) Any ONE of: • Category A system • Category B system • Category C system	(1 mark)	AS/NZS 3000 Table 3.5	
(ii) Any ONE of: • Category A 500 mm	(½ mark)	AS/NZS 3000 Table 3.6	

Question 1	*Marks*	*Reference*	*Marking notes*
• Category B 500 mm		Figure 3.11 AS/NZS 3000 Table 3.6	
or			
Category B 575 mm		AS/NZS 3000 Figure 3.14	
• Category C 50 mm		AS/NZS 3000 Table 3.6 Figure 3.16	
(iii) Any ONE of:	(½ mark)		
• Category A 300 mm		AS/NZS 3000 Table 3.6 Figure 3.10	
• Category B 300 mm		AS/NZS 3000 Table 3.6	
or			
Category B 375 mm		AS/NZS 3000 Figure 3.13	
• Category C 50 mm		AS/NZS 3000 Table 3.6 Figure 3.16	
(e) Any TWO of:	(2 marks)		
• Armoured sheathed cables		AS/NZS 3000: 3.11.3.1(d)	
• Neutral-screened cables		AS/NZS 3000: 3.11.3.1(d)	
• Neutral-screened cables suitable for underground protection		AS/NZS 3000: Table 3.5 Column 8	
• Sheathed armoured and served cables		AS/NZS 3000: Table 3.5 Column 8	
(f) Any TWO of: • Protective earthing conductors connecting exposed conductive parts as required • Main earthing conductor • Main earthing terminal, connection or bar. • MEN connection between the main earthing terminal, connection or bar and the supply neutral bar. • Earth electrode • Equipotential bonding of extraneous conductive and other parts as	(2 marks)	AS/NZS 3000: 5.3.1	

Question 1	*Marks*	*Reference*	*Marking notes*
required			
(g) Any ONE of: - Must be protected by a RCD with a fixed rated residual current of 30 mA - Supplied individually as a separated circuit in accordance with clause 7.4	(2 marks)	AS/NZS 3000: 6.2.4.2(c)(i) Table 6.1 AS/NZS 3000: 6.2.4.2(c)(ii) Table 6.1	
(h) Any ONE of: - A fault in one safety service will not result in loss of supply to other safety services - A fault on the general installation will not result in loss of supply to safety services.	(2 marks)	AS/NZS 3000: 7.2.2.2(a) 2.5.7.2.2(a) AS/NZS 3000: 7.2.2.2(b) 2.5.7.2.2(b)	
(i) - An SELV circuit is not connected to earth or protective earthing conductors that are part of other circuits or other live parts	(1 mark)	AS/NZS 3000 7.5.5	
- A PELV circuit has one conductor that is earthed	(1 mark)	AS/NZS 3000 7.5.6	
(j) (i) Any ONE of: - 4 m - 1.5 m with written consent from the owner	(1 mark)	ECP 34 9.2.1(a)	
(ii) 300 mm	(1 mark)	ECP 34 Table 10	

Question 2				*Marks*	*Reference*	*Marking notes*
(a)	Section 8 of AS/NZS 3000			(1 mark)		
(b)	(i)	4.	Replaced existing final subcircuits with conductors of the same size.	(1 mark)	ESR 6A (1)	
		8	Replaced fluorescent light fittings with new fittings of the same rating as the original			
	(ii)	2.	An MEN main switchboard that has a higher current rating than the original.	(2½ marks)	ESR 6A (3)	
		3.	Installed three new final subcircuits.			
		5.	Installed a new sub-main to a new storage building.			
		6.	Installed a new distribution switchboard in the new storage building.			
		7.	Installed new final subcircuits in the new storage building			
	(iii)	1.	New consumers mains from a new point of supply.	(½ mark)	ESR 6A (2)	
(c)	(i)	1.	New consumers mains from a new point of supply.	(3 marks)	ESR 65 (3), (4)	
		2.	An MEN main switchboard that has a higher current rating than the original.			
		3.	Installed three new final subcircuits.			
		5.	Installed a new sub-main to a new storage building.			
		6.	Installed a new distribution switchboard in the new storage building.			
		7.	Installed new final subcircuits in the new storage building			
(b)	(i)	8	Replaced fluorescent light fittings with new fittings of the same rating as the original	(½ mark)	ESR 6A (1)	The 2nd (b) and (c) are alternatives to the original (b) and (c)
	(ii)	3.	Installed three new final	(2½ marks)	ESR 6A (3)	

Question 2	*Marks*	*Reference*	*Marking notes*
subcircuits. 4. Replaced existing final subcircuits with conductors of the same size. 5. Installed a new sub-main to a new storage building. 6. Installed a new distribution switchboard in the new storage building. 7. Installed new final subcircuits in the new storage building			
(iii) 1. New consumers mains from a new point of supply. 2. An MEN main switchboard that has a higher current rating than the original.	(1 mark)	ESR 6A (2)	
(c) (i) 1. New consumers mains from a new point of supply. 2. An MEN main switchboard that has a higher current rating than the original. 3. Installed three new final subcircuits. 4. Replaced existing final subcircuits with conductors of the same size. 5. Installed a new sub-main to a new storage building. 6. Installed a new distribution switchboard in the new storage building. 7. Installed new final subcircuits in the new storage building	(3 marks)	ESR 65 (3), (4)	
(ii) Any ONE of: • A person authorised to certify the prescribed electrical work to which the certificate relates • In the case of prescribed electrical work carried out under an employer licence, the person is authorised to certify the work under the system of operation used by the employer. • The electrician	(1 mark)	ESR 68	

Question 2	*Marks*	*Reference*	*Marking notes*
(iii) Any ONE of: • The person who issued it • If the person who issued the certificate of compliance was acting under an employer licence, the holder of the employer licence. • The electrician • The responsible person	(1 mark)	ESR 74E (1)	

Question 3	*Marks*	*Reference*	*Marking notes*

Equipment	**Load Group**	**Calculation**	**Load (A)**	
8, 60W lights	A	8 x (60 ÷ 230) = 2.087		(1 mark)
10, 250W lights	A	10 x (250 ÷ 230) = 10.87		(1 mark)
30, 8W lights	A	30 x (8 ÷ 230) = 1.04		(1 mark)
16 m Track	A	16 x 0.5 = 8		(1 mark)
		2.87 + 10.87 + 1.04 + 8 =	22	(1 mark)
10, single socket outlets	B(i)	10 +1+20 = 31		(1 mark)
1 single socket outlet	B(i)	(1 x 1000) + (750 x 30) = 23500		(1 mark)
10, 10A double socket out lets	B(i)	23500 ÷ 230 =	102.17	(1 mark)
1, 6 kw air conditioner	C	6000 ÷ 230 =	26.09	(1 mark)
Maximum demand			150.26	(1 mark)

The maximum demand can be between 146A and 154A

AS/NZS 3000: Table C2, Column 3

Question 4	*Marks*	*Reference*	*Marking notes*
(a) (i) Any ONE of:	(2 marks)		
• Shall be protected against overheating, by design or installation, in all service conditions.		AS/NZS 3000: 4.8.1	
• Protection shall be provided by means of an appropriate non-self-resetting device, functioning independently of the thermostat.		AS/NZS 3000: 4.8.1	
• Operation, inspection and adjustment of easing equipment of pressure-relief devices for unvented water heaters		AS/NZS 3000: 4.8.2.1(a)	
• Operation, inspection and adjustment of all terminals of the protective devices for unvented water heaters		AS/NZS 3000: 4.8.2.1(b)	
• Overtemperature cut-outs and similar protective devices fitted to unvented water heaters shall operate directly in the circuit wiring to the heater elements		AS/NZS 3000: 4.8.2.2(a)	
• Overtemperature cut-outs and similar protective devices fitted to unvented water heaters shall not be arranged for control through cut-outs or contactors.		AS/NZS 3000: 4.8.2.2(b)	
(ii) • Every water heater shall be provided with an independent isolating device	(1 mark)	AS/NZS 3000: 4.8.2.3	
• The device shall be additional to any automatic switch in the heater structure	(1 mark)	AS/NZS 3000: 4.8.2.3(a)	
• Any ONE of: * Installed adjacent to the water heater. * Installed on the switchboard at which the water heater final subcircuits originates.	(1 mark)	AS/NZS 3000: 4.8.2.3(c)	
(b) Any ONE of:	(2 marks)		
• The current carrying capacity shall		AS/NZS 3000:	

Question 4	*Marks*	*Reference*	*Marking notes*
be not less than 135% of the rated current of the capacitor - The current carrying capacity shall be not less than the setting of the circuit breaker		4.15.2.3(a) AS/NZS 3000: 4.15.2.3(b)	
(c) Any ONE of: - The conductors shall have current rating of not less than one-third of the rating of the motor-circuit conductors. - The conductors shall have current rating of not less than 135% of the rated current of the capacitor	(2 marks)	AS/NZS 3000: 4.15.2.3(i) AS/NZS 3000: 4.15.2.3(ii)	
(d) 370W	(1 mark)	AS/NZS 3000: 4.13.2	

Question 5	*Marks*	*Reference*	*Marking notes*
(a) (i) Any ONE of:	(1 mark)		
• The means of isolation shall be such that a deliberate action in addition to the normal method of operation is required to energise the circuit.		AS/NZS 3000: 2.3.2.1	
• Devices for shutting down for mechanical maintenance shall be designed or installed so as to prevent unintentional closure.		AS/NZS 3000: 2.3.6.2(c)	
(ii) A notice shall be placed in such a position that any person gaining access to live parts will be warned of the need to isolate those parts from various supplies.	(1 mark)	AS/NZS 3000: 2.3.2.1	
(b) Any TWO of: • Consumers mains • Equipment installed as required by an electricity distributor for service protection, control or electricity consumption metering purposes • Ancillary equipment, measuring devices, and associated wiring …… provided that this wiring and equipment are confined within or on the switchboard. • Equipment ……… associated with a safety service that is connected on the supply side of a main switch • Equipment ……… associated with alternative supply system that is connected on the supply side of a main switch • Fault current limiters. • Surge diverters installed to protect consumers mains or main switchboards.	(2 marks)	AS/NZS 3000 2.3.3.1	
(c) Domestic installations shall have not more than one main switch for	(1 mark)	AS/NZS 3000: 2.3.3.2	
• Each separately metered supply	(1 mark)	AS/NZS 3000: 2.3.3.2(a)	
• Where that is more than one separately controlled supply, a main switch for each of the separately controlled supply	(1 mark)	AS/NZS 3000: 2.3.3.2(b)	

Question 5	*Marks*	*Reference*	*Marking notes*
(d) Functional switching may be used where switching of electrical equipment or part of an electrical installation is required for operational control only and not for safety reasons.	(1 mark)	AS/NZS 3000: 2.3.7.1	
(e) Any ONE of: ● Consumers mains. ● Where the neutral conductor is used as a combined protective earthing conductor and neutral (PEN) conductor for protective earthing of any portion of an electrical installation.	(2 marks)	AS/NZS 3000: 2.3.2.1.1 (b)(i)(A) AS/NZS 3000: 2.3.2.1.1 (b)(i)(B)	

Question 6	*Marks*	*Reference*	*Marking notes*
(a) Any THREE of:			
• RCD protection is required for final subcircuits supplying one or more socket outlets	(1 mark)	AS/NZS 3000: 2.6.3.1(a) 1.5.6.3(a)	
• RCD protection is required for final subcircuits supplying lighting points	(1 mark)	AS/NZS 3000: 2.6.3.1(b) 1.5.6.3(a)	
• RCD protection is required for final subcircuits supplying directly connected hand-held electrical equipment.	(1 mark)	AS/NZS 3000: 2.6.3.1(c) 1.5.6.3(a)	
• Where the number of RCDs installed exceeds one and more than one lighting circuit is installed, lighting circuits shall be distributed between RCDs		AS/NZS 3000: 2.6.2.4(a)	
• Not more than three final subcircuits shall be protected by any one RCD		AS/NZS 3000: 2.6.2.4(b)(i)	
• Where there is more than one final subcircuit, a minimum of two RCDs shall be installed		AS/NZS 3000: 2.6.2.4(b)(ii)	
• Where all of the circuit protection on a switchboard is replaced, additional protection by RCDs as required by clause 2.6 shall be provided for final subcircuits supplied from that switchboard.		AS/NZS 3000: 2.6.3.4	
• Socket outlets that are added to an existing circuit shall be protected by an RCD		AS/NZS 3000: 2.6.3.4	
(b) (i) The socket outlet final subcircuits must be protected by RCDs with maximum rated residual current of 10 mA	(1 mark)	AS/NZS 3000: 2.6.3.2.2	
(ii) Any THREE of:	(3 marks)		
• *It has* a rated residual current not exceeding 10 milliamperes.		ESR 24(6)(a)	
• *I*t has a rated residual current of 10 milliamperes or less and interrupts the current in all live conductors within 300 milliseconds when passing its rated residual current		ESR 24(6)(b)(i)(A)	

Question 6	*Marks*	*Reference*	*Marking notes*
● It has a rated residual current of 10 milliamperes or less and interrupts the current in all live conductors within 40 milliseconds when passing 5 times its rated residual current ● *I*t has a rated residual current of 10 milliamperes or less and it does not interrupt the current in all live conductors when passing leakage current at or below half its rated residual current.		ESR 24(6)(b)(i)(B) ESR 24(6)(b)(ii)	
(c) (i) ● Provided that the socket outlet is located in a position that is not likely to be accessed for general purposes ● Provided that the socket outlet is clearly marked to indicate the restricted purposes of the socket outlet and that RCD protection is not provided.	(1 mark) (1 mark)	AS/NZS 3000: 2.6.3.1 Exception 3(a) AS/NZS 3000: 2.6.3.1 Exception 3(b)	
(ii) The current leakage from the MIMS elements could cause nuisance tripping of the RCD.	(1 mark)	GK	

Question 7	*Marks*	*Reference*	*Marking notes*
(a) • Black must be used for the colour of the neutral conductors	(1 mark)	ESR 20(2)(c)(i)	
• Black cannot be used as a colour for any other conductors	(1 mark)	ESR 20(2)(c)(i)	
(b) Any TWO of:	(2 marks)		
• They shall be used for protective earthing or equipotential bonding conductors		AS/NZS 3000 Table 3.4	
• They shall not be used as active or neutral conductors		AS/NZS 3000 3.8.1 **1.7.2(f)**	
• They cannot be sleeved at any point to be identified as an active or neutral conductor.		AS/NZS 3000 3.8.2	
(c) • Each conductor of a multi-core cable is clearly identifiable by means of numbering, lettering or equivalent means	(1 mark)	AS/NZS 3000 3.8.3.2(a)	
• Conductors of flexible cords and cables are identified by alternative colours in accordance with clause 3.8.3.3	(1 mark)	AS/NZS 3000 3.8.3.2(b)	
• Insulated aerial conductors are identified by a number of small longitudinal ribs around the circumference.	(1 mark)	AS/NZS 3000 3.8.3.2(c)	
(d) They shall not be installed through any space formed between the wall-lining and roofing material and its immediate supporting member.	(1 mark)	AS/NZS 3000: 3.9.4.3.1	
(e) Any ONE of: • Where the final subcircuits originate from the same supply. • The continuity of the neutral conductor shall not depend on connections at the terminals of electrical equipment including control switches. • Final subcircuits that contain a common neutral shall be controlled and protected by linked circuit breakers or linked switches • The neutral conductor shall be	(2 marks)	AS/NZS 3000: 2.2.1.2	Clause 2.9.5.5 is alternative reference to the 4th bullet point.

Question 7	*Marks*	*Reference*	*Marking notes*
marked at switchboards to identify the associated live conductors in accordance with clause 2.9.5.5 - Alternative sources of supply to a single appliance shall have a common isolating switch.			

Question 8	*Marks*	*Reference*	*Marking notes*
(a) (i) A MCB	(1 mark)	GK	
(ii) It is the ratio of the MCB minimum tripping current to the MCB current rating.	(1 mark)	GK	
(b) ● The protective device must be capable of safely clearing that level of prospective short-circuit current without damage.	(1 mark)	GK	
● To ensure the protective device can operate within the minimum permitted time.	(1 mark)	GK	
(c) 50V a.c.	(1 mark)	AS/NZS 3000: 1.5.5.3 (b)	
(d) ● The breaking capacity shall be not less than the prospective short-circuit current at the point where the devices are installed.	(1 mark)	AS/NZS 3000: 2.5.4.5(a)	
● All currents caused by a short circuit occurring at any point of a circuit shall be interrupted before the temperature of the conductors reaches the permissible limit.	(1 mark)	AS/NZS 3000: 2.5.4.5(b)	
(e) Any TWO of:	(2 marks)		
● 0.4s for final subcircuits that supply socket-outlets having rated currents not exceeding 63 A		AS/NZS 3000: 1.5.5.3 (d) 5.7.2(a), (b)	
● 0.4s for final subcircuits that supply hand-held Class I equipment			
● 0.4s for final subcircuits that supply portable equipment intended for manual movement during use.			
● 5s for circuits including submains and final subcircuits supplying fixed or stationary equipment.			
(f) Any ONE of:	(1 mark)		
● It shall be capable of breaking any overcurrent up to and including the prospective short-circuit current at the point where the device is installed.		AS/NZS 3000: 2.5.2	
● An overload protective device that complies with clause 2.53 and has a breaking capacity not less than the		AS/NZS 3000: 2.5.6.1	

Question 8	*Marks*	*Reference*	*Marking notes*
value of the prospective short-circuit current at the point of installation maybe deemed to protect the conductor on the load side at that point against short-circuit current and overload currents			

Question 9			Marks	Reference	Marking notes
(a)	(i)	Any ONE of: ● To minimize the risk associated with the occurrence of voltage differences between exposed conductive parts of electrical equipment and extraneous conductive parts. ● Electrical connections intended to bring exposed conductive parts or extraneous conductive parts to the same, or approximately the same potential, but not intended to carry current in normal service.	(2 marks)	AS/NZS 3000: 5.6.1 AS/NZS 3000: 1.4.52	
	(ii)	$4mm^2$	(1 mark)	AS/NZS 3000: 5.6.3.2(a)	
	(iii)	Any ONE of: ● If mechanical damage is likely to occur. ● To reduce the fault loop impedance. ● Equipotential bonding conductor in explosive atmospheres	(1 mark)	AS/NZS 3000: 5.6.3.2 AS/NZS 3000: 5.6.3.2 Note	
	(iv)	To avoid any potential differences that may occur between conductive material connected to, or in contact with, the electrical installation earthing system or earthed electrical equipment and the concrete floor.	(1 mark)	AS/NZS 3000: 5.6.2.5 Note 1	
(b)	(i)	● Where it is separated from the live conductors by double insulation; and	(1 mark)	AS/NZS 3000: 5.5.3.2 Exception 1(a)	
		● Sheathed or covered overall with non-conductive material; and	(1 mark)	AS/NZS 3000: 5.5.3.2 Exception 1(b)	
		● All joints to and terminations of the screen or braid are suitably separated from exposed metal and live parts.	(1 mark)	AS/NZS 3000: 5.5.3.2 Exception 1(c)	

Question 9	*Marks*	*Reference*	*Marking notes*
(ii) Any FOUR of:	(2 marks)		
• Festoon-type lampholders of the all-insulated type.		AS/NZS 3000: 5.4.3(a)	
• Luminaires that are earthed by their attachment to screwed metallic conduit or pipe		AS/NZS 3000: 5.4.3(b)	
• Luminaires installed outdoors on a non-conductive pole where the luminaires are not in an earthed situation.		AS/NZS 3000: 5.4.3(c)	
• ELV lighting points.		AS/NZS 3000: 5.4.3(d)	
• Where in accordance with clause 5.4.1 earthing of electrical equipment is not required.		AS/NZS 3000: 5.4.4 Exception (a)	
• Where in accordance with clause 5.4.3 earthing of electrical equipment is not required.		AS/NZS 3000: 5.4.4 Exception (b)	
• Where installed outdoors on a non-conductive pole and the luminaire is not in an earthed situation.		AS/NZS 3000: 5.4.4 Exception (c)	
• Where supplied at ELV is accordance with clause 7.5		AS/NZS 3000: 5.4.4 Exception (c)	
• Luminaries installed in Zone 0 of a swimming pool		AS/NZS 3000: 6.3.4.5	
• Any Class II luminaire		GK	